National Security Education Center

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# Information Science and Technology Center Seminar

**Jonathan Yedidia**
**Mitsubishi Research**
**Cambridge, MA**

## "Probabilistic Inference Using Divide & Concur and Belief Propagation"

**Wednesday, June 23, 2010**
**3:00 - 4:00 PM**
**TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)**

**Abstract:** In "probabilistic inference" problems one tries to estimate the true state of some quantities of interest, given only noisy or ambiguous sensor measurements of related quantities. Such problems arise in a very wide variety of fields, with applications in communications, signal processing, computer vision, speech and audio recognition, machine learning, physics, and robotics. A common formalism that can be used to attack all these problems is using message-passing algorithms that operate on "factor graphs."

In this talk, I will describe and compare two particularly important algorithms for probabilistic inference: the celebrated "belief propagation" (BP) algorithm; and the "divide and concur" (D&C) algorithm recently developed by Gravel and Elser, which I will show can also be understood as a message-passing algorithm. I will describe the relative advantages of the two algorithms, as well as various methods that can improve their performance. The D&C algorithm has some notable advantages compared with BP, in that it more naturally deals with problems with continuous valued variables, or with variables that lack local evidence. Another advantage of D&C is that its "difference-map" dynamics enables it to avoid "traps."

I will also describe a new decoder (developed with Yige Wang and Stark Draper) for low-density parity check codes that combines the ideas of the D&C and BP algorithms. This "difference-map belief propagation" (DMBP) decoder significantly improves error-floor performance compared with state-of-the-art BP decoders, while maintaining a similar computational complexity.

**Biography:** Dr. Jonathan Yedidia is a Distinguished Research Scientist in the Algorithms group at Mitsubishi Electric Research Laboratory (MERL). Since joining MERL in 1998, he has worked on the theory of message-passing probabilistic inference algorithms, as well as their applications, including error-correcting codes and decoders, phase-unwrapping algorithms, secure biometric systems, video encoding systems, and computer vision systems.

Dr. Yedidia received his Ph.D. in theoretical physics in 1990 at Princeton University. His graduate work at Princeton and post-doctoral work at the Harvard Society of Fellows focused on algorithms for analyzing the behavior of disordered physical systems such as glasses and disordered magnets. In 1997, while working at the startup Viaweb, he helped develop a shopping search engine that became Yahoo's shopping service. He is also an international master in Chess.

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**For more information contact the technical host Misha Chertkov, chertkov@lanl.gov, 665-8119**
**or the institutional host Frank Alexander, fja@lanl.gov, 665-4518.**
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